



DA42MPP – SCS Rack User's Manual

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Version 2.15.02
SD200878A

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1 Welcome

1.1 Welcome

Welcome to the world of advanced communication... welcome to the world of SCOTTY!

This manual has been designed to help you take full advantage of your SCOTTY solution. It is not only a comprehensive guide to the operation of the system, it also provides technical details, simple step by step instructions on how to perform the most common applications, and more. We recommend you read this manual carefully in order to fully benefit from SCOTTY's advanced solutions.

Company background

SCOTTY founded in 1994 and is headquartered in Austria.

By recognising niche markets and offering customised products for specialised applications, SCOTTY has gained enormous expertise in the development of live video, audio and data communication through satellite and terrestrial networks.

Market sectors

- portable solutions
- vehicle solutions
- maritime solutions
- aero solutions
- encryption solutions

Please find detailed information on our website: www.scottysgroup.com

1.2 Customer Support

Contacting SCOTTY's Customer Services & Technical Support:

| | |
|--------------------------------------|--|
| Europe, Middle East, Africa, Asia | +43 316 409 426 support.emea@scottysgroup.com |
| The Americas | +1 770 825 0574 support.americas@scottysgroup.com |

If you need urgent help for your SCOTTY solution, call the customer support number:

| | |
|--------------------------------------|--|
| Europe, Middle East, Africa, Asia | Austria (UTC +1): +43 664 454 2827 |
| The Americas, Asia | Atlanta, USA (UTC -6): +1 770 380 7186 |

Please always include the serial number of your SCOTTY unit or license.

Videoconference test numbers

H.320 ISDN numbers (64 kbit/s and 2x64 kbit/s):

- Austria: +43 316 407849
- USA: +1 770 246 9082

H.323 IP number (up to 512 kbit/s):

- Austria: 193.154.221.198
or demograz.scottysgroup.com
- USA: 209.155.96.99
or demoatlanta.scottysgroup.com

2 System Description

2.1 The SCOTTY DA-42 MPP System

The SCOTTY Group and Diamond Airborne Sensing present a versatile and efficient surveillance solution: the SCOTTY/Diamond DA42 Multi-Purpose Platform (MPP). This twin-turboprop has been outfitted with an observation camera, a radio system for line of sight operation, a satellite link for beyond line of sight usage, and a map generator system.

The video of the observation camera can be recorded locally in full TV quality, and/or sent to a control station in real-time over the radio or the satellite link.

The radio link uses latest digital transmission technologies to achieve a large operation range. Two radio links are used, one for a high-quality video transmission, and a second one for the transmission of telemetry data from the map generator.

The satellite link uses the world-wide INMARSAT network. By using the IP-based INMARSAT SwiftBroadband (SBB) or combining up to four ISDN-based INMARSAT Swift64 satellite channels, video rates up to 256 kbit/s are possible, using the latest video protocol H.264 to achieve the maximum video quality.

A map generator system (optional) allows both local and remote operation, allowing remote tracking of a mission. Data exchange with the control station is done using the radio or satellite link, in parallel with the video transmission.

The full setup consists of the following components:

- Diamond DA-42 MPP airplane

With its long-range capabilities ideally suited as an airborne platform for surveillance operations.

- SCOTTY SATCOM Rack DA42MPP - SCS

The video processing and communication unit integrating these functions:

- INMARSAT satellite transceiver
- Windows compatible computer
- Live video processing hardware
- High-quality video recorder
- System control and maintenance software
- Controllable camera with optical and FLIR capabilities
- Map Generator with telemetry data exchange (optional)
- Operator console, including video monitors, camera control panel, keyboard and mouse
- Radio subsystem with transmitters and antennas for video and telemetry transmission
- Antenna subsystem for communication with the INMARSAT satellite network
- Inertial Reference System as reference for the map generator and the antenna positioning

3 Operation

3.1 Operation

In the following section we want to make the user familiar with the basic functions of the system. Powering up the system, using it, and maintenance tasks are described step by step to be carried out very easily.

For the details about the operation of the SCOTTY SCS Computer System, please refer to the SCOTTY SCS HD User's Manual.

For detailed information for the other subsystems, please refer to the corresponding manufacturer's manuals.

3.2 Video Selection

During operation, the video shown on the aircraft's screens can be selected:

- Operator Console: Left Screen
 - **VID1 (Input 1):** Camera Video
 - **MAP1 (VGA 1):** Map Generator
- Operator Console: Right Screen
 - **VID1 (Input 1) :** Camera Video
 - **MAP1 (VGA 1) :** SCOTTY SCS Computer System
- Pilot Screen
 - **C1:** Camera Video
 - **C2:** Map Generator

3.3 Line Of Sight Operation

Line of sight (LOS) uses a radio link between the aircraft and the control station to transmit video and telemetry data. It can be used when the aircraft is close enough to the ground station. Its usage is free of costs.

3.3.1 Power-On Procedure

1. Both engines must run
1. Switch on **Bus#2** (Camera)
2. Switch on **Bus#3** (Video Radio)
2. Switch on **Bus#4** (Avalet Screens & Map Generator)
3. Switch on **Bus#5** (Data Radio)
4. Switch on **Bus#6** (Pilot Screen & Video Splitter)
5. Switch on **Mission Master**

The System is now ready to transmit video and telemetry information.

3.3.2 Operation

After power-on, the system automatically transmits the camera video and the telemetry information.

3.3.3 Power-Down Procedure

1. Switch of Camera (**Stow** and **Power off**)
2. Switch of Map Generator (**F1** → **Shut down** → **Enter**)
3. Switch of **Bus#6**
4. Switch of **Bus#5**
5. Switch of **Bus#4**
6. Switch of **Bus#3**
7. Switch of **Bus#2**
8. Switch off **Mission Master**
9. Turn off the engines

3.4 Beyond Line Of Sight Operation - SBB

The beyond line of sight (BLOS) operation uses the worldwide INMARSAT satellite network to connect with a control station. It can be used even when the aircraft is too far away to use the line of sight link.

The INMARSAT SwiftBroadband (SBB) service is IP-based, but also allows voice calls. It is usually operated in “background mode”, where the available satellite bandwidth is shared between the different subscribers; costs arise only when traffic is transferred. In addition to video and telemetry transmission, the BLOS system allows voice calls to regular telephones, and file transfer from or to the aircraft.

To use the SBB service, a SIM card provided by the service provider needs to be put into the INMARSAT transceiver.

3.4.1 Power-On Procedure

1. Both engines must run
2. Switch on **Bus#1** (SCOTTY Rack)
3. Switch on **Bus#2** (Camera)
4. Switch on **Bus#4** (Avalex Screens & Map Generator)
5. Switch on **Bus#6** (Pilot Screen & Video Splitter)
6. Switch on **Mission Master**
7. Operator Console, right screen: Select **MAP1 (VGA 1)**
8. Enable **PASS3** (Passenger 3) audio on the Garmin Audio Panel
9. Verify that SCS starts
 - a. **Windows** must boot up
 - b. **Scotty Teleport** application must start automatically
 - c. Verify camera video in the **Video** window. If the camera it is not powered on, a color bar must be shown.
10. Wait until the Satcom Transceiver is ready for call
 - a. Start Software **EMSHSDControl** by double-clicking **EMSHSD01**
 - b. Verify that the values under **Flight Information** are valid (**GPS, Heading, Roll, Pitch, True Track, Speed**)
 - c. Verify that the selected **Satellite** is **EUMEA, Americas, or APAC**
 - d. Value for **C/No** must be greater than 48 db/Hz
 - e. **Status** must be **Starting BGAN Lower** and a **Frequency** is displayed; other messages may appear before

The System is now ready to make calls.

3.4.2 Video Call Procedures

Making a video call:

1. Make sure that the Satcom Transceiver is ready for call, using the **EMSHSDControl** software; see Power-On Procedure for details
2. Make sure that the INMARSAT network is connected. If not, connect by double-clicking **INMARSAT SBB Background** on the desktop:



3. In the **Teleport** application, select the **Dial** button:



4. Select the remote station, e.g. the appropriate **Groundstation** entry.
5. Click on **Dial** to connect.
For a call with lower bandwidth, click on **Low Cost**.

Terminating a call:

1. The ongoing call can be terminated by clicking the **Dial** button:



2. Click on **Yes**.
3. If no more calls shall be made, disconnect the **INMARSAT SBB Background** connection by double-clicking on the **INMARSAT SBB Background** icon on the desktop and choosing **Disconnect**. Alternatively, you can disconnect the connection by right-clicking on the systray icon in the taskbar and choosing **Disconnect**.

Receiving a video call:

1. Make sure that the INMARSAT network is connected. If not, connect by double-clicking **INMARSAT SBB Background** on the desktop.
2. An incoming call is announced by the **Incoming Call** dialog box of the opened **Teleport** application. Click **Yes** to accept the call.
3. The ongoing call can be terminated by clicking the **Dial** button.
4. If no more calls shall be made, disconnect the **INMARSAT SBB Background** connection.

3.4.3 Optional: VPN and MCU Video Call Procedures

Optionally, the system can establish an encrypted connection with the ground station using VPN. Now, connections to a conference on the optional MCU are possible, or to other equipment connected to the ground station's network.

Making a MCU video call:

1. Make sure that the Satcom Transceiver is ready for call, using the **EMSHSDControl** software; see Power-On Procedure for details
2. Make sure that the INMARSAT network is connected. If not, connect by double-clicking **INMARSAT SBB Background** on the desktop:



3. Make sure that the VPN connection is established. If not, double-click on the appropriate **Groundstation** icon on the desktop.
4. In the **Teleport** application, select the **Dial** button:



5. Select **Groundstation - MCU @ VPN**
6. Click on **Dial** to connect.
For a call with lower bandwidth, click on **Low Cost**.
7. In Teleport, open the tone pad with **View | Tone Pad**
8. Follow the instructions on screen and use the tone pad to select a running conference, or to create a new one.

Terminating a call:


1. The ongoing call can be terminated by clicking the **Dial** button:




2. Click on **Yes**.
3. If no more calls shall be made, disconnect the **Groundstation** VPN link and the **INMARSAT SBB Background** connection.

3.4.4 Voice Call Procedures

Making a voice call to a regular telephone:

1. Make sure that the Satcom Transceiver is ready for call, using the **EMSHSDControl** software; see Power-On Procedure for details
2. In the **Teleport** application, select the **Dial** button:

3. Select the remote station, or directly enter the phone number:
+ <country-code> <number>, e.g. +43 316407849
4. Click on **Voice Only** to connect.


Terminating a call:

1. The ongoing call can be terminated by clicking the **Dial** button:

2. Click on **Yes**.

Receiving a voice call:

1. The remote station calls one of the SBB voice numbers provided by the service provider.
2. An incoming call is announced by the **Incoming Call** dialog box of the opened **Teleport** application. Click **Yes** to accept the call.
3. The ongoing call can be terminated by clicking the **Dial** button.

3.4.5 Power-Down Procedure

1. Switch off SCS
 - a. Close the **Teleport** main window with  and select **Yes**.
 - b. Click on **Start** on the lower left corner.
 - c. Click on **Turn Off Computer**.
 - d. Select the option **Turn Off**.
 - e. Wait until the system has shut down
2. Switch of Camera (**Stow** and **Power off**)
3. Switch of Map Generator (**F1** → **Shut down** → **Enter**)
4. Switch of **Bus#6**
5. Switch of **Bus#4**
6. Switch of **Bus#2**
7. Switch of **Bus#2**
8. Switch off **Mission Master**
9. Turn off the engines

3.5 Beyond Line Of Sight Operation – Swift64

The INMARSAT Swift64 service is an ISDN-based service, allowing voice and data calls with the regular telephone network. The SATCOM Rack features four channels, which can be bundled together for higher call rates.

To use the Swift64 service, a forward ID for the INMARSAT transceiver must be provided by the service provider and installed into the SATCOM Rack.



Default system configuration is SBB service only. Therefore, if not ordered by the customer, the system will not be configured for Swift64 usage.

3.5.1 Power-On Procedure

1. Both engines must run
2. Switch on **Bus#1** (SCOTTY Rack)
3. Switch on **Bus#2** (Camera)
4. Switch on **Bus#4** (Avaex Screens & Map Generator)
5. Switch on **Bus#6** (Pilot Screen & Video Splitter)
6. Switch on **Mission Master**
7. Operator Console, right screen: Select **MAP1 (VGA 1)**
8. Enable **PASS3** (Passenger 3) audio on the Garmin Audio Panel
9. Verify that SCS starts
 - f. **Windows** must boot up
 - g. **Scotty Teleport** application must start automatically
 - h. Verify camera video in the **Video** window. If the camera it is not powered on, a color bar must be shown.
10. Wait until the Satcom Transceiver is ready for call
 - i. Start Software **EMSHSDControl** by double-clicking **EMSHSD01**
 - j. Verify that the values under **Flight Information** are valid (**GPS, Heading, Roll, Pitch, True Track, Speed**)
 - k. Verify that the selected **Satellite** is **AORE, AORW, IOR** or **POR**
 - l. Value for **C/No** must be greater than 48 db/Hz for all 4 channels
 - m. **Status** must be **no call** for all 4 channels. If registration is still in progress, wait until **Successfully registered** is shown; other messages may appear before

The System is now ready to make calls.

3.5.2 Video and Voice Call Procedures

Making a video call:

1. Make sure that the Satcom Transceiver is ready for call, using the **EMSHSDControl** software; see Power-On Procedure for details
2. In the **Teleport** application, select the **Dial** button:



3. Select the remote station, or directly enter the phone number:
+ <country-code> <number>, e.g. +43 316407849
- 4.
5. Click on **Dial** to connect a two channel call.
For a call using only one channel, click on **Low Cost**.
For a voice call, click on **Voice Only**.

For a four channel call, select **256 kbit/s** in the field **Dial Rate**, and click on **Dial**. This will use the unique SCOTTY Live Bonding feature for a stable and reliable call; this feature needs to be available on the remote station as well.

Terminating a call:

1. The ongoing call can be terminated by clicking the **Dial** button:




2. Click on **Yes**.

Receiving a call:

1. The remote station needs to call the system's phone numbers provided by the service provider:
 - For a voice call, call one of the voice numbers of the first channel.
 - For single channel and SCOTTY Live Bonding video calls, the data number of the first channel must be used.
 - For a two channel call, use the data numbers of the first two channels, separated by a comma.
2. An incoming call is announced by the **Incoming Call** dialog box of the opened **Teleport** application. Click **Yes** to accept the call.
3. The ongoing call can be terminated by clicking the **Dial** button.

3.5.3 Power-Down Procedure

1. Switch off SCS
 - a. Close the **Teleport** main window with  and select **Yes**.
 - b. Click on **Start** on the lower left corner.
 - c. Click on **Turn Off Computer**.
 - d. Select the option **Turn Off**.
 - e. Wait until the system has shut down
2. Switch of Camera (**Stow** and **Power off**)
3. Switch of Map Generator (**F1** → **Shut down** → **Enter**)
4. Switch of **Bus#6**
5. Switch of **Bus#4**
6. Switch of **Bus#2**
7. Switch of **Bus#2**
8. Switch off **Mission Master**
9. Turn off the engines

3.6 Snapshot and Video Recording Operation

The camera video can be recorded locally on the system in high-quality for later reference by taking high resolution snapshots and by making video recordings. The pictures and videos can be reviewed on the system, taken from the system using an external USB device, or even transferred directly from the aircraft to the ground station using the SCOTTY Filetransfer feature.

Snapshots and recordings can be used in parallel to each other and parallel to line of sight (LOS) and beyond line of sight (BLOS) operation.

3.6.1 Power-On Procedure

1. Both engines must run
2. Switch on **Bus#1** (SCOTTY Rack)
3. Switch on **Bus#2** (Camera)
4. Switch on **Bus#4** (Avaalex Screens & Map Generator)
5. Switch on **Bus#6** (Pilot Screen & Video Splitter)
6. Switch on **Mission Master**
7. Operator Console, right screen: Select **MAP1 (VGA 1)**
8. Verify that SCS starts
 - a. **Windows** must boot up
 - b. **Scotty Teleport** application must start automatically
 - c. Verify camera video in the **Video** window. If the camera it is not powered on, a color bar must be shown.

3.6.2 Taking a Snapshot

1. Click on the **Snapshot** button.
2. The snapshot is saved as JPEG file under **D:\Scotty\Records**



3.6.3 Recording a Video

1. From the standard toolbar of the SCOTTY main window select the **Recorder** button.
2. Start the recording.
3. Stop recording. The recording is saved with an automatically assigned name under **D:\Scotty\Records**.



3.6.4 Transfer using SCOTTY Filetransfer

Pictures and Video files can be transferred to a remote system using the SCOTTY Filetransfer feature. Whereas this feature is perfectly suited to send the high resolution snapshots, it should be used only for short video clips, recorded at low quality settings.


Using the SCOTTY Filetransfer is similar to the beyond line of sight operations. It can be used stand-alone, or even during a video call.



In INMARSAT SwiftBroadband (SBB) and SCOTTY Live Bonding modes, a Filetransfer during a video call should only be used for small files. For best performance:

*In SBB mode, transfer stand-alone and, in the **Phone Book**, switch Interface to **LAN-UDP**.*


In INMARSAT Swift64 mode, use Filetransfer with two channel calls.

1. Make sure that the system is ready to make calls. If not, follow the beyond line of sight power-up operation procedures
2. From the standard toolbar of the SCOTTY main window select the **File Transfer** button.

3. Click on **Add**.
4. In the **Open** dialog select the file(s) to transmit and press **Open**.
5. Repeat Steps 3 and 4 to add several files to the displayed list.
6. Click on **Send**.
 - a. If the system is already in a video call, the transfer immediately starts.
 - b. If the system is not in a video call, the **Phone Book** is displayed (Stand-alone mode). Follow the beyond line of sight video call procedures, and see the note above.

3.6.5 Transfer to External USB Device

1. Attach external USB device to the USB port of the system
2. Open **Windows Explorer**
3. Browse to **D:\Scotty\Records**
4. Move desired files to the USB device
5. Before removing the USB device, use Window's **Safely remove Hardware** feature, or shut down the system.

3.6.6 Power-Down Procedure

1. Switch off SCS
 - a. Close the **Teleport** main window with  and select **Yes**.
 - b. Click on **Start** on the lower left corner.
 - c. Click on **Turn Off Computer**.
 - d. Select the option **Turn Off**.
 - e. Wait until the system has shut down
2. Switch of Camera (**Stow** and **Power off**)
3. Switch of Map Generator (**F1** → **Shut down** → **Enter**)
4. Switch of **Bus#6**
5. Switch of **Bus#4**
6. Switch of **Bus#2**
7. Switch of **Bus#2**
8. Switch off **Mission Master**
9. Turn off the engines

4 System Configuration

4.1 Changing INMARSAT Settings



Usually, no configuration is required as SCOTTY already configures all necessary settings. A wrong configuration can render the system inoperative.

How to access the INMARSAT transceiver:

1. Start software **EMSHSDControl** by double-clicking **EMSHSD01**
2. Click on the **Open Terminal...** button.
3. Enter “**maint**” (no echo displayed). **MENU 1** should be displayed.
4. Use “**Ctrl+N**” and “**Ctrl+O**” to navigate through the menus

Change Satellite:

Enter **MENU 4**, and press “**O**” (**set ocean region**).

Select satellite. Recommended setting: “**-1**” (**auto**)

Press Enter if requested “**do you want to change immediately?**”

Switch to SwiftBroadband (SBB) IP-Based Mode:

Enter **MENU 3**, and press “**M**” (**misc. eeprom parameters**)

Type “**97**” (**enter channel card configuration**)

For **Channel Card #1** press “**B**”, “**6**”, “**1**” (**BGAN, 6x, No Fallback to Swift64**)

For **Channel Card #2** press “**N**” (**Not used**)

Reset HSD by pressing the **Test** button on front of the transceiver.

Switch to Swift64 ISDN-Based Mode:

Enter **MENU 3**, and press “**M**” (**misc. eeprom parameters**)

Type “**97**” (**enter channel card configuration**)

Press “**S**” two times (**Swift64**)

Reset HSD by pressing the **Test** button on front of the transceiver.

Swift64 Mode: Change your INMARSAT provider:

Enter **MENU 3**, and press “**I**” (enter all LES id’s)

Enter the ID of your provider, e.g. “002”.

Swift64 Mode: Forward ID:

The INMARSAT provider defines the forward ID for the system. It is coded into a hardware plug, accessible through a hatch on the right side of the SATCOM Rack. Contact SCOTTY to provide a plug when a new forward ID is required.

4.2 Setup of the INMARSAT Transceiver



Usually, no configuration is required as SCOTTY already configures all necessary settings. A wrong configuration can render the system inoperative.

In case the HSD-400 configuration has been damaged, follow these directions.

1. Access the INMARSAT transceiver - see previous chapter
2. Switch to **MENU 2**.
3. Press “**T**” (**enter time of day**) and enter current date and time.
Follow the syntax given, e.g. “7/1/2008 9:50:00”
4. Switch to **MENU 3**.
5. Press “**M**” (**misc. eeprom parameters**)
6. Enter “**3**” (**GPS protection algorithms**) and enter “**0**” (**disabled**)
7. Press “**=**” (**select reports**)
8. Press “**X**” (**turn off all reports**)
9. Enter “**21**” (**on call codes**)
10. Enter “**23**” (**on standard output**)
11. Enter “**51**” (**on one second tick**)
12. Enter “**91**” (**on hsd frequencies**)
13. Press “**S**” (**save to eeprom**)
14. Select SwiftBroadband (SBB) or Swift64 mode – see previous chapter
15. Swift64 Mode: Select your provider – see previous chapter
16. Select Satellite – see previous chapter
17. Reset HSD by pressing the **Test** button on front of the transceiver.

5 Calibration

5.1 Introduction

The SCOTTY IRS Subsystem is required for the antenna pointing. On delivery of the aircraft, the system is already calibrated; and a **new calibration is usually not required**.

After major changes have been applied to the aircraft, if it was hit by lightning strike, or if the satellite signal strength is reduced, the IRS data should be compared to the data of the aircraft's IRS system.

1. Start software **EMSHSDControl** by double-clicking **EMSHSD01**
2. Compare the IRS data shown in the section **Flight Information** with the aircraft's pitch, roll and heading data shown by the GARMIN cockpit.

CAUTION: The **EMSHSDControl** software shows the true heading, the aircraft might show the magnetic heading. Depending on the current location, a magnetic field correction of the magnetic heading must be added or subtracted to calculate the true heading.

If the measurements show inaccurate IRS data, the SCOTTY IRS system needs to be re-calibrated as laid out in this chapter.

5.2 Calibration



Usually, no calibration is required as SCOTTY already pre-calibrates the system. A wrong calibration can render the system inoperative.

1. All calibration steps are performed in the aircraft with the engine power and electrical loads as indicated below:
 - a. Both engines must run at 1800 RPM
 - b. **AV Master** switch on

- c. All available avionics equipment on
 - d. Rotating beacon and strobe on
 - e. Lights should be on
2. Taxi to a compass calibration location clear of large metal objects.
3. On the SCOTTY Rack, set the **MAINT AHRS** switch to **ON**
4. Switch on **Bus#1** (SCOTTY Rack)
5. Switch on **Bus#4** (Avalet Screens & Map Generator)
6. Operator Console, right screen: Select **MAP1 (VGA 1)**
7. Wait until SCS starts
8. Click on the **AHRS-Calibration** icon to start the calibration software
9. Inside the calibration software, select **COM3** port
10. Press **Calibrate**
11. Select the mount orientation **Mount Position 8** and click **Next >**
12. Follow the on-screen instructions:
 - a. The program will ask for the AHRS power to be turned off. Turn off AHRS by pulling the **IRS** fuse on the SCOTTY Rack.
 - b. Wait for the screen prompt before turning power back on by pushing in the **IRS** fuse. Note: After recycling the power the AHRSSstatus window will turn red for approximately 2 minutes.
 - c. Do not move the aircraft.
13. Perform **Step 2: Coarse calibration**:
 - a. Physically point the aircraft precisely to north using the magnetic heading shown by the Garmin cockpit. Do not use the compass displayed by the software!
 - b. Wait until **Rate Meter** is inside the green area
 - c. Click the **Calibrate North** button
 - d. A green **OK** appears in the text box
 - e. Repeat the steps above for east, south and west. Note: The calibration can be done in any order.
 - f. Click **Next >** button to proceed to the next step.
14. Perform **Step 3: Fine calibration**
 - a. Repeat the calibration steps for the four cardinal headings as described before.
15. Click **Store Configuration Module** to store the calibration data.